

ROCK FOUNDATIONS FOR SKYSCRAPERS

Concrete Genii Dig Deep for the Safety of Modern Aladdin's Palaces.

COSTLY BUT SURE METHOD

An Account of the Foundation Work in the Municipal Building—New Methods Employed.

"And the rain descended and the floods came and the winds blew and beat upon that house, and it fell not, for it was founded upon a rock."

The construction of the modern skyscraper is carefully orthodox. He has gone back to his scriptures and has given proper cellar and sub-cellars accommodations.

South of this point, the story is quite different. Rock bottom is found in gen-

eral at depths varying between 50 and 100 feet beneath the surface, making the question of foundation for the tall office building a very serious one, overlying the rock bed is a ten-foot layer of hardpan, a cemented mass of clay and disintegrated rock evidently deposited during the glacial period and formed by the pressure above it into a hardened substance which often is mistaken even by experts for concrete.

In the excavations for the Singer and United States Express buildings, shells of extinct species were found in this hardpan.

Above this hardpan are layers of treacherous quicksands, in places 60 feet thick and of coarser sands. These layers have been built up by deposits of sand and silt by the tides and currents in recent geological times, much of this matter being disintegrated rock from the Jersey shore. The ground water level is found at from ten to thirty feet below the street level. The dangerous character of the quicksands that underlie the surface in this lower New York may be realized from the fineness of this sand, much of which will pass through a sieve the openings of which are 35 one-thousandths of an inch in width. These fine sands are saturated with water. Foundation construction engineers point to this sand as one of their fundamental difficulties, for when water is pumped from a pit the sand is pumped with it and the pumping drawing the sand from under adjoining buildings may undermine them.

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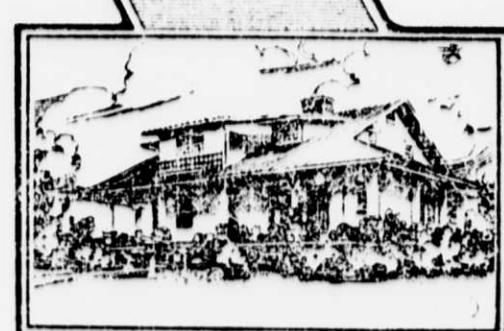
—for the magnificent McAlpin Hotel or the cozy cottage among the suburbs of Jersey, there are equally strong reasons for the use of

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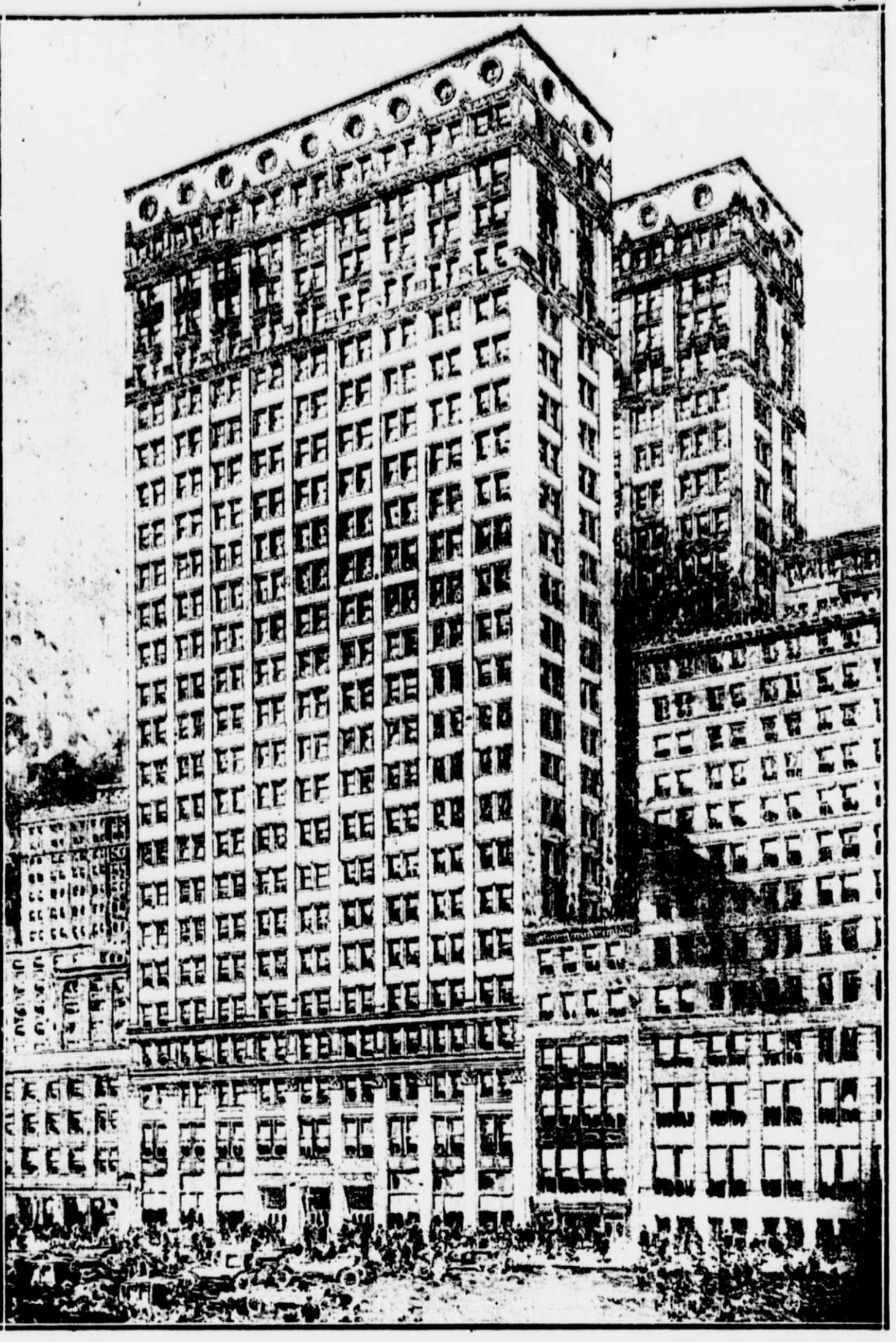


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fingers of the genie, thus sunk in the ground, is concentrated all the flavor of Arabian Nights' mystery. In these great finger-tips are veritable caves of Aladdin embedded in the rock-piles of concrete otherwise known as the working chambers of the caissons, where the spirit of the genie is laboring, devouring and gobbling up the earth beneath to make room for the relentlessly growing concrete fingers of the genie above until they shall rest on rock bottom.

The helpers of the genie in these de-sounding caves of Aladdin are the "sand-hogs" of New York, who have made possible the 20, 30 and 40 story office buildings of lower Manhattan by standing them on foundation rock. Then when the piers are finished and the piers along the line of the walls of the building have been connected by concrete joints to make a solid, watertight concrete box dropped down and in length and width the dimensions of the building, and when the skyscraper on top has been completed, what have you but a twentieth century geological formation—a solid piece of rock springing up out of a rock bed, through the quicksands into the air?

The first building in New York city whose foundations were constructed by the pneumatic compressed air caisson process was the Manhattan Life building, erected in 1882. Since then 10 others have been built. Slossomith and Company were the pioneers in New York. They were supplanted by The Engineering Contract Company, which in turn, about ten years ago, was succeeded by the present concern, The Foundation Company, which builds nothing else but foundations. When the structure of a skyscraper begins to rise above the surface of the ground the work of The Foundation Company is finished.

The Municipal Building, now in course of construction, furnishes one of the latest examples of the method and its foundation is one of the most remarkable pieces of such work that has been done. The work of The Foundation Company was performed under extremely difficult conditions in this instance because of the honey-combed nature of the ground, which was crossed with water, sewer, and gas mains, electric light, telephone and telegraph wire conduits, the subway along its west walls, elevated railroad piers along the east side, the Brooklyn Bridge Terminal at the south, and, not least of the obstructions, a temporary bridge structure over the excavation to carry Chambers Street, which runs through the centre of the present building. The Chambers street traffic could not be interrupted and the water and sewer mains and the railroad structure had to be insured against settling in the least, even while the work was

soonest after the fashion of a bulldozer cutter. There are two forms of this box, called the "working-chamber"; one circular and the other rectangular. The largest rectangular working chamber used in the Municipal Building construction work was 36 feet in width by 31 feet in length. This is means, though the most expensive, is also the largest ever sunk for a building by the diamond drill, a hollow pipe line foundation. The average size is 8 whose cutting edge is set with stones 24 feet, with head room between diamonds. This drill cuts down 6 and 7 feet. Pipes are let into the through the sand and hardpan and roof of the box to admit the supply rock and bring up a core which is compressed air. There is also the an exact section of the earth shaft held in the roof of the working beneath. The other method is by wash chamber through which the bulk bores, cheaper but not convincing, carrying the excavated earth is passed out to the ground level and through

which also the men pass in and out of the chamber by means of a ladder. The working chambers are built of wood, steel, reinforced concrete.

The working chamber is now ready to descend into the earth. A foreman and usually four hand-hogs enter it and dig away the earth from underneath, thus undermining the edges. The excavated material is hoisted out in cylindrical buckets, which in the case of the Municipal Building varied in diameter from 22 to 24 inches and in height from 33 to 46 inches and carried about a cubic yard of earth each. Before the working chamber has begun to sink, however, the concrete column is started on top of it and built up into the air to a height varying between 15 and 50 feet. The concrete of this

method is sharpened steel. By means of water sent down through a smaller pipe within the larger one, the earth is loosened and the pipe sunk. When this drill strikes rock, it stops. For this reason, it is of small value for deep borings, as often it will be thought that rock bottom has been struck when only a boulder has been hit. It was exactly this that happened in the first borings made for the Municipal Building. They were wash borings and went down to a depth of about 135 feet below the street level. When 21 supplementary borings were made by The Foundation Company after it had been awarded the contract for the foundation, it was found that bedrock on the northern part of the land for the building lay at a depth of from 50 to 80 feet below the boulder that had been struck by the wash borings. These diamond borings showed a curious situation in this case of the Municipal Building. Three-quarters of the lot, at the southern end, possessed bedrock at an average depth of 130 feet below the street level with rock bottom at the northern end of the lot sloped off very abruptly toward Duane street into a kind of small ravine or chasm, whose greatest depth inside the lot was 200 feet below the street and just outside the space of the building was 338 feet below the street level.

The original plan of the city authorities, which had been to sink the piers to a depth of 60 feet below the street, was changed to provide for the sinking of 68 caisson piers to rock bottom on the southern end of the lot and on the northern end of 28 such piers to a depth of 37 feet below the street level. It is impossible by present means to sink a caisson more than about 100 feet below water level, and here the depth was 175 feet below the water line. Though the northern pier of the building therefore rests on sand, it is considered certain that the depth is sufficiently great to secure the sand against settlement as the pressure per square foot is the moderate measure of 6 tons to the square inch instead of the 15 tons to the square foot the rock bottom piers will bear. The piers supporting the tower rest on rock.

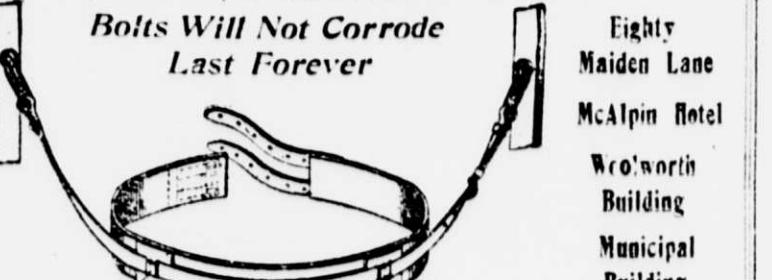
The total weight of the Municipal Building increased by the weight of its contents and by the stresses due to wind pressure, is estimated at about 165,000 tons. This weight is carried by 12 columns supported on 108 caissons on concrete piers. The depth of these caissons, 112 feet below water level, is the greatest to which caissons have been sunk by this process. The total cost of the foundation was \$1,453,147.

After the borings have been completed the work of sinking the caissons begins. Imagine a bottomless box set on the ground, having its lower edge set with a steel cutting rim, the whole soonest after the fashion of a bulldozer cutter. There are two forms of this box, called the "working-chamber"; one circular and the other rectangular. The largest rectangular working chamber used in the Municipal Building construction work was 36 feet in width by 31 feet in length. This is means, though the most expensive, is also the largest ever sunk for a building by the diamond drill, a hollow pipe line foundation. The average size is 8 whose cutting edge is set with stones 24 feet, with head room between diamonds. This drill cuts down 6 and 7 feet. Pipes are let into the through the sand and hardpan and roof of the box to admit the supply rock and bring up a core which is compressed air. There is also the an exact section of the earth shaft held in the roof of the working beneath. The other method is by wash chamber through which the bulk bores, cheaper but not convincing, carrying the excavated earth is passed out to the ground level and through

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